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PEND OREILLE LAKE

(tributary to Pend Oreille River)

Summary

Pend Oreille Lake was added to the 1994 303(d) list, and retained on the 1996 list, as a water quality "threatened" waterbody, due to the increasing amount of nutrients in the lake and the threat of metals pollution from the Clark Fork River. This problem assessment concludes that the lake is not expected to exceed any water quality standard due to declining water quality within the next two years. Because no violation is expected within this time frame, EPA, Region 10 does not consider the lake a "threatened" water body and no TMDL for nutrients or metals will be written for it at this time. It is recommended that the Tri-State Implementation Council be supported in their efforts to develop a voluntary nutrient reduction plan for this waterbody.

1. Physical and Biological Characteristics

Pend Oreille Lake is the 21st largest natural freshwater lake and the 5th deepest in the United States. Surface area of the lake is 91,180 acres (369 km^2). Lake levels are controlled by Albani Falls dam operated by the U.S. Army Corps of Engineers. Normal full-pool elevation is 2,062 feet (628 m) mean sea level (USGS 1996) and normal drawdown around the first of December is 2,051feet (625.1 m). Due to the water level fluctuations and shoreline development, bank erosion is severe in some areas.

The nearest U.S. Geological Survey water quality monitoring station is located below the Cabinet Gorge dam on the Clark Fork River near the Idaho-Montana border. No annual water quality monitoring is being conducted on the lake other than the occasional volunteer monitoring effort.

The lake is characterized by two distinct morphometric basins. The large deep southern basin has a surface area of 57,377 acres (232 km^2) and a mean depth of 721 feet (220 m) and contains about 95% of the lake's volume (Woods 1991b). The mean hydraulic residence time of the deep basin is likely in excess of ten years (Falter et al. 1992). The northern basin is characterized by a relatively shallow mean depth of 95 feet (29 m) and a mean hydraulic residence time of much less than one year (Falter et al. 1992). It is heavily influenced by the inflow of the Clark Fork River which provides 92% of the lake's water (Frenzel 1991).

Pend Oreille Lake is used extensively for recreation. Over one million visitors used public recreational facilities in 1985, and 30,000 angler days were recorded for that year also. The lake is also used as a supplemental water supply for the City of Sandpoint and as a main water source for many individual homes along the lake.

2. Pollutant Source Inventory

Point Source Discharges

There are ten point source discharge permits with effluent limitations along the Clark Fork River in Montana. There are seven dischargers in Idaho's portion of the Pend Oreille watershed, six of which have National Pollution Discharge Elimination System (NPDES) permits. Only four Idaho discharges enter above or into the lake. These dischargers are:

1. Cabinet Gorge Dam - Clark Fork River (unpermitted)
2. Cabinet Gorge Hatchery - Clark Fork River
3. Clark Fork Hatchery - Spring Creek
4. Kootenay-Ponderay Sewer District - Boyer Slough

1. The Cabinet Gorge Dam treats their domestic wastewater using a package treatment plant (aeration chamber, clarifier, chlorine contact chamber) and discharges it to the Clark Fork River. The EPA in a letter dated January 9, 1991, indicated that they were unable to prepare an NPDES permit at that time for the discharge, and recommended that Washington Water Power meet state water quality standards until the time that EPA can issue a permit for it. Idaho DEQ set effluent limits for the discharge and established a monitoring plan. Compliance with this agreement has been sporadic both in monitoring frequency and meeting effluent limits. The EPA has not yet issued a permit for this discharge.

2. The Cabinet Gorge Hatchery, operated by the Idaho Department of Fish and Game, is a kokanee trout hatchery with 64 raceways, 3 production ponds, a fish ladder and a settling pond. Maximum production is 45,000 pounds of kokanee per year. Their NPDES permit was effective May 23, 1989 and expired June 21, 1994 (permit #ID-002661-1). The permit has not been re-issued. Reporting by Idaho Fish and Game is current and the discharge appears to be within the allowed effluent limits.

3. The Clark Fork Fish Hatchery is also operated by the Idaho Fish and Game and has 10 raceways, two production ponds and a settling pond. Maximum production was 50,000 lbs of cutthroat, 300 lbs of rainbow, 2,000 lbs of kokanee, 20 lbs of brook trout and 100 lbs of brown trout per year. Their NPDES permit was effective on October 22, 1990 and expired on October 23, 1995. An application for re-issuance of this permit was made to EPA on April 26, 1995 which indicated a change of production to rainbow, cutthroat and brook trout only, and an increase in production by 27,580 lbs/yr and an increase of feed by 10,000 lbs/yr. The permit has not been re-issued by EPA. Reporting by Idaho Fish and Game is current and the discharge appears to be within the allowed effluent limits.

The Clark Fork Hatchery and the Cabinet Gorge Hatchery permits have identical effluent limits for their settling ponds, however, there is an additional discharge allowed for the cleaning of the waste treatment system at the Cabinet Gorge facility. This addition allows approximately twenty times the amount of total suspended solids and ten times more settleable solids to be discharged during cleaning than the settling pond effluent limits. The Cabinet Gorge permit does not allow discharge of this wastewater, indicating that it should be disposed of on an upland site. In reviewing the discharge monitoring reports for the Clark Fork Hatchery, it appears that this additional effluent allowance is (1) not necessary and (2) not consistent with similar NPDES permits.

4. The Kootenai-Ponderay Sewer District each year discharges 1,432 kg total phosphorus and 9,929 kg total nitrogen into Boyer Slough which flows into Pend Oreille Lake. This discharge accounts for 0.4% of the phosphorus and 0.2% of the nitrogen load entering Pend Oreille Lake and River. For comparison purposes, the City of Sandpoint discharges

4,250 kg total phosphorus and 29,470 kg total nitrogen annually to the mouth of the Pend Oreille River. The treatment plant was originally permitted in 1975, the permit was revised in 1984 and expired in 1989. For fourteen years ('69 – '83) the treatment plant provided only primary treatment of sewage before discharging to Boyer Slough. In 1984 a sand filter system was added to meet secondary treatment rules.

In summary, this system has a troubled history, ranging from severe infiltration and inflow, noncompliance with monitoring requirements, exceeding effluent limits and an emergency discharge of wastewater in 1996 of 1.04 million gallons. The District has continually responded to problems with equipment upgrades and increasing maintenance. Due to the rapid growth of these two communities the system is currently undergoing expansion plans with the addition of a land application site. This will not reduce the amount of nutrients discharged to the lake.

A proposed discharge into the Clark Fork River from the ASARCO Rock Creek mine would introduce metals and nutrient pollution to the river and Pend Oreille Lake. However, as stated by the USEPA in a letter to Montana DEQ dated April 8, 1998, "Our calculations, based upon low flow conditions in the Clark Fork River, as outlined in the draft permit, indicated that proposed effluent limitations will not cause a violation of water quality standards in the Clark Fork River, nor cause a measurable increase in the concentration of any parameter at the Montana-Idaho border.". The project has not yet obtained an operating or discharge permit.

Nonpoint Source Discharges

The Clark Fork-Pend Oreille Basin Water Quality Study, (EPA, 1993) identifies the near shore littoral zone as the primary location for water quality problems in the lake. The areas of highest algae growth, which correlates with areas of higher phosphorous loadings, were found along shorelines with significant residential development. Phosphorous loadings from local tributaries also reflected the near shore findings, that the higher degree of urban development the higher the phosphorous loading. Factoring in the land area drained by tributaries, the Pack River and Sand Creek contribute the largest loads of phosphorus to the lake. Lightning Creek, Pack River and Sand Creek contribute the largest loads of nitrogen. The Clark Fork River contributes the least amount of nutrients per unit of land drained, however, due to the huge volume of water entering the lake, the Clark Fork River contributes approximately 80% of the phosphorus and 81% of the nitrogen load (Hoelscher et al. 1993).

Other nonpoint sources which contribute nutrients to the lake are the result of land disturbing activities such as silviculture, agriculture, grazing, septic tanks, and urban runoff. Eighty three percent (83%) of the Pend Oreille watershed is forested. Forest practices play a large role in determining the water quality of many of the tributaries which flow into the lake (Figure 1). Currently, nineteen (19) tributaries are listed as water quality impaired due to excess sediment, temperature, nutrients, and flow and habitat alterations. These water quality limited streams are addressed separately from the lake.

Other sources which introduce nutrients to the lake are agriculture, grazing, septic systems, and urban runoff. Agriculture accounts for 4% of the land use in the watershed, and occurs primarily

in flat valley bottoms around Cocolalla Lake. Grazing comprises about 3% of the watershed. Failed septic systems along the lake contribute to near shore eutrophication. Stormwater from urban areas flows into the lake, most with minimal or no treatment. Contribution of pollutants to the lake from this source has not been quantified.

2. a. Summary of Past and Present Pollution Control Efforts

As a result of citizen concerns about increased aquatic weed and algae growth in the Clark Fork River, Pend Oreille Lake and Pend Oreille River, the U.S. Congress added language to the 1987 Clean Water Act Amendments (P.L. 100-4, Feb. 4, 1987) that directed EPA to study the sources of nutrient pollution in the basin. A comprehensive three year study led to the development of the Clark Fork-Pend Oreille Basin Water Quality Study, A Summary of Findings and a Management Plan (EPA 1993), designed to protect and restore water quality in the watersheds from nutrient pollution. The Tri-State Implementation Council (later changed to Tri-State Water Quality Council) was established in October 1993, to oversee implementation of the Plan. The Council consists of representatives from counties, cities, tribes, citizen groups, businesses, industries and state and federal agencies. The Council provides oversight to eleven (11) ad hoc subcommittees who are working at the local level to put into effect the specific action items from the management plan. Accomplishments of the Council to date are:

1. A basin wide phosphate detergent ban.
2. A Voluntary Nutrient Reduction Plan, approved by Montana DEQ and EPA and developed cooperatively with major point source dischargers establishes a target nutrient load for the middle Clark Fork River.
3. Created a "Watershed Trunk" game for grade school use.
4. Initiated the Missoula and Sandpoint Water Festivals.
5. Offered educators tours of the watershed; Arranged for a continuing education college course about watersheds.
6. Coordinates with Washington DOE on milfoil control.
7. Promote and facilitate regional sewer planning. Ellisport Bay sewering is currently underway.
8. Instituted major improvements to the City of Missoula, Deer Lodge and Butte wastewater treatment systems.
9. Established and currently maintaining a water quality monitoring network throughout the basin.
10. Assisted Bonner County in developing an effective stormwater and erosion control ordinance.

Washington Water Power, as part of their relicensing process for the Noxon and Cabinet Gorge hydro-power projects, agreed to the following protection, mitigation and enhancement measures (PM&Es) (Federal Energy Regulatory Commission 1998)*:

1.	Idaho Tributary and Fishery Enhancement Program	$400,000/yr for 45 years
2.	Fish Passage/Native Salmonid Restoration Plan	$400,000/yr for 45 years
3.	Bull Trout Protection and Public Education	$125,000/yr for 45 years
4.	Watershed Council Program	$ 10,000/yr for 45 years

5.	Support of Tri-State Implementation Council	$ 15,000/yr for 45 years
6.	Monitoring of Noxon Reservoir Stratification and Mobilization of Sediment, Nutrients/Metals	$ 4,000/yr for 45 years
7.	Implementation of Land Use Management Plan	$ 75,000/yr for 45 years
8.	Wildlife Habitat Acquisition and Enhancement Fund	$ 192,000/yr for 45 years
9.	Wetlands on WWP Property	$ 50,000/yr for 45 years
10.	Clark Fork Delta Habitat	undetermined yrly amt.
11.	Erosion Fund and Shoreline Stabilization Guidelines Program	$ 50,000/yr for 5 years+ $ 40,000/yr for 40 years

*The above list is not inclusive. Some PM&Es have been excluded and funding amounts shown are only the annual contributions.

Many of these relicensing projects will benefit the water quality of Pend Oreille Lake also. Stream improvement projects, fish passage projects, habitat restoration, bank stabilization and similar types of activities will benefit both the lake fishery and lake water quality. Funding over the next 45 years should result in a substantial number of improvement projects being achieved.

In 2001, the federal stormwater permit program will be extended to communities of 10,000 or more in population. This program requires that communities work towards improving the water quality of their stormwater discharges to surface or groundwater through the use of best management practices. The City of Sandpoint is presently coordinating with the State to insure that they meet EPA's permitting requirements (T. Maguire personal communication 1998).

The Idaho Forest Practices Act may soon have the addition of the Cumulative Watershed Effects Process for Idaho (Idaho Cumulative Effects Task Force 1995) added to it as a tool to evaluate problem watersheds. This process enables the forest practices advisor to recommend additional protection measures to address cumulative effects of timber harvest. In areas which have been heavily roaded, over harvested, or with unstable geology, site specific Best Management Practices developed from this process should significantly reduce sedimentation of streams. This will benefit the lake since tributaries contribute significant amounts of nutrients to the lake, often transported by adhesion to sediment particles.

Improvements

1. The Clark Fork River contributes 80-85% of the total phosphorus loading to the lake. With the announcement of the Voluntary Nutrient Reduction Plan agreement for the middle Clark Fork and its nutrient reduction schedule, the threat to the lake has decreased. It should continue to decrease with the work of the Tri-State Implementation Council as they focus next on the lower Clark Fork.

2. Pack River, Sand Creek and Lightning Creek discharge the highest level of nutrients per unit of land to the lake. Many of the major tributaries to the lake require TMDL development and implementation. A large percentage of these watersheds are federally owned, and therefore, full compliance with the TMDLs is expected.

3. The listing of the bull trout as federally threatened will also indirectly aid in the

maintenance and improvement of lake water quality through implementation of the recovery plan.

4. The Washington Water Power relicensing settlement includes substantial amounts of money for stream enhancement projects, public education, habitat acquisition, gas supersaturation studies, water quality monitoring and bank stabilization. They will also fund an aquatic organism tissue analysis study to determine if past metals contamination from the Clark Fork superfund sites require human health related fish consumption advisories. These projects will provide direct long term benefits to the water quality of the lake.

5. Until this time, the Special Resource Water designation (IDAPA 16.01.02.056) has been strictly interpreted by DEQ to be very protective of water quality. Although this policy could change, thus far it has protected Pend Oreille Lake and the Clark Fork River from the authorization of additional point source discharges.

6. In 1993 Bonner County adopted a stormwater ordinance which, if enforced, would provide for adequate protection of the lake and its tributaries from sedimentation as a result of various land disturbing activities.

7. The City of Sandpoint is involved in early coordination with DEQ to be prepared to meet the new federal stormwater regulations which become effective in 2001. These rules will address stormwater discharges to surface water and groundwater and require a uniform level of pre-treatment. Involvement and concern for clean water in a community is a positive indication that water quality improvements will be a high priority.

3. Water Quality Concerns and Status

In 1994 the lake was added to the 303(d) list as a water quality "threatened" waterbody, due to the increasing amount of nutrients in the lake and the threat of metals pollution from the Clark Fork River (EPA 1994). Although water quality standards had not been violated, the Clean Water Act, as interpreted by the U.S. Environmental Protection Agency (EPA), allows a waterbody to be listed as "threatened" to avoid an impending impaired status. This provision is found in 40 CFR130.07.(b)(5) and stated below:

> [As part of the state's Continuing Planning Process:] "Each State shall assemble and evaluate all existing and readily available water quality-related data and information... about the following categories of waters: (I) Waters identified by the State in its most recent section 305(b) report as "partially meeting" or "not meeting" designated uses or as "threatened";"

The EPA, Region 10 has interpreted the meaning of a "threatened" water to be a declining trend in water quality which will not meet water quality standards within the next listing period, i.e. two years (EPA 1995).

The primary water quality concerns for the Pend Oreille Lake are as follows:

Nutrients

Since the listing in 1994, there have been numerous successful efforts to reduce nutrients in the watershed, most notably in the upper and middle Clark Fork River. Lagging behind is the effort to reduce nonpoint sources of nutrient pollution related to near shore development around the lake and pollutants entering the lake from tributary streams, most notably the Pack River, Lightning Creek and Sand Creek. Of these three streams, two are on the 1996 303(d) list and will require load reductions. The third, Sand Creek, may be listed in the future. The most effective means of addressing this issue is through local land use ordinances, which must not only be enacted, but vigorously enforced and supported by the public.

The Tri-State Water Quality Council has been very successful in its development of a voluntary nutrient reduction plan for the middle Clark Fork River. They have recently developed a Voluntary Border Nutrient Load Agreement for the Lower Clark Fork River to protect open waters of Pend Oreille Lake from degradation. It is expected that both Idaho and Montana will sign this agreement (see Appendix D).

In February 2001 the EPA and Idaho DEQ decided to proceed with a near shore TMDL for Pend Oreille Lake in light of public comment expressed after DEQ proposed that the lake be de-listed. A considerable number of people indicated that near shore water quality has been declining. Attached and suspended algae and the odor of decaying vegetation were noted by the public. The 2000 census results showed population growth far above those projected by Hoelscher *et al.* (1993) in his lake response model. Hoelscher determined that with the projected population growth rate (35,081 by 2010) the difference between oligotrophic and mesotrophic conditions would be reduced by one half in twenty years. The twenty year population figure Hoelscher used was actually reached in 1998. Without controls to prevent increasing amounts of nutrients from entering the lake, near shore areas will decline and become increasingly dominated by algae and other aquatic plants. The absence of near shore data and the changes observed in the phytoplankton community composition over the past twenty years (EPA 1993), compelled Idaho DEQ and EPA to reconsider the de-listing proposal. In March 2001, the Tri-State Council was awarded a grant from EPA to develop the near shore TMDL and implementation plan. It is scheduled to be completed by December 2001.

Metals

Metals reduction has been achieved by the partial clean up of the Clark Fork River superfund sites and other point source reductions. However, there remains public concern about the potential metals pollution from a proposed hard rock mine (Rock Creek) which would discharge to the Clark Fork in Montana. As part of the process to determine the downstream effects of a discharge in a different state, Region 8 of the EPA, in a letter to Montana DEQ and the U.S. Forest Service dated April 8, 1998 analyzed the project and concluded that the mine's discharge will not violate Idaho water quality standards.

Gas Saturation

It was discovered in 1998 that water quality standards for gas saturation have been exceeded in the Clark Fork River and Pend Oreille Lake due to nitrogen gas supersaturation from the Cabinet Gorge and Noxon Rapids hydroelectric dams. This problem is being addressed by Washington

Water Power as part of their relicensing agreement. DEQ will address the gas supersaturation problem once it has fulfilled its obligations outlined in the April 1997 TMDL Development Schedule.

Fisheries

It is presently unknown if the lake is fully supportive of two native fish species, the federally threatened bull trout and the westslope cutthroat trout (presently under review for listing under the Endangered Species Act). The lake is critical habitat for completion of the bull trout life cycle. Impairment of bull trout habitat due to water quality may be from water level fluctuations (flow), gas supersaturation, and near-shore nutrient enrichment (Corsi et al.1998).

Eurasian Milfoil

Eurasian milfoil was discovered for the first time upstream of the Albani Falls dam. Shallow bays and near shore areas of the lake are now threatened by the invasion of this nuisance exotic plant. The County's response to battling the spread of Eurasian milfoil has been aggressive and timely. Cooperation with Idaho Fish and Game, U.S. Army Corps of Engineers, and Idaho Department of Agriculture has aided in the effort to prevent the further spread of the weed. The Washington Department of Ecology has listed their portion of the Pend Oreille River as water quality impaired due to exotic weeds. Their exists a possibility for a similar listing for the lake in the future.

NPDES Permits

None of the point source dischargers have current NPDES permits. Re-issued permits should reflect public concerns for water quality of the lake, be consistent, and require particular attention to nutrient reduction.

Idaho Water Quality Standards

The mixing zone rules for lakes and reservoirs allows a mixing zone size not to exceed ten percent (10%) of the surface area of the lake (IDAPA 16.01.02.060.01.f.). This amounts to a little less than thirteen square miles in Pend Oreille Lake before the discharge must meet standards (which is no reduction of ambient water quality for special resource waters). If the intent is to protect existing water quality of the lake, then consideration should be given to strengthening the rules for special resource waters or increasing the protection of the lake to an "outstanding resource water" level. (See section 3.a. for a more detailed discussion of this issue.)

3. a. Applicable Water Quality Standards

The state water quality standards under IDAPA 16.01.02.200.06 has a narrative description of what comprises unacceptable levels of nutrients in state surface waters. It states, "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." Public concern about water clarity and algae growths played a large role in listing the lake as threatened. A secondary reason for the listing was concern over metals pollution entering the lake from the Clark Fork River. The state water quality standards protect against metals pollution through the adoption of the National Toxics Rule (57CFR 60848, Dec. 22, 1992). This rule establishes maximum

concentrations for various toxic substances, including metals, which are protective of human and aquatic life. Criteria are provided for both acute and chronic concentrations.

The lake has some additional protection by being designated as a Special Resource Water (IDAPA 16.01.02.110). This designation protects the lake from discharges which would cause a measurable reduction in ambient water quality below the *applicable mixing zone*. The pollutant must also be significant to a designated beneficial use. An *applicable mixing zone* is defined as an area where water quality standards can be exceeded in not more than 10% of the surface area of the lake. This would allow for a mixing zone in Pend Oreille Lake of a little less than thirteen (13) square miles. At the edge of this mixing zone the diluted wastewater must be the same as, or better, than the surrounding water quality of the lake, but inside this mixing zone the lake can exceed chronic water quality criteria. Without the Special Resource Water designation water outside the mixing zone would have to support all designated beneficial uses but could be reduced in quality. An example of this would be the Pend Oreille River.

The Pend Oreille Lake and Clark Fork River are protected for all beneficial uses except warm water biota. The Special Resource Water designation also limits existing dischargers to their current permit capacities.

3. b. Summary and Analysis of Existing Water Quality Data

The three-year Clark Fork-Pend Oreille Basin Water Quality Study, A Summary of Findings and a Management Plan (EPA 1993) yielded the following major research findings and conclusions about the Pend Oreille Lake:

- Open lake water quality has not changed statistically since the mid-1950s.

- There is a high correlation between total phosphorus loading from near shore and local tributaries and the degree of urban development. [Note discussion concerning this study found on page 57.]

- Ninety percent (90%) of the water entering the lake comes from the Clark Fork River inflow, as does 85% [this percentage differs depending on the document referenced, the range is 80 - 85%] of the total loading of phosphorus, the nutrient that limits algae growth in the lake.

- Maintenance of open lake water quality is largely dependent upon maintaining nutrient loadings from the Clark Fork River at or below present [1993] levels.

- Pack River, followed by Sand Creek, are the tributaries discharging the highest phosphorus loads per unit of land area to the lake. Lightning Creek, Pack River, and Sand Creek have the highest nitrogen levels.

*Recommended management objectives of the plan include:

- Protect Pend Oreille Lake water quality by maintaining or reducing current rates of

nutrient loading from the Clark Fork River.

Reduce nearshore eutrophication in Pend Oreille Lake by reducing nutrient loading from local sources.

* These recommended management objectives have been partially achieved, largely due to the efforts of the Tri-State Implementation Council (section 2.a.).

Based upon the Phase I Diagnostic and Feasibility Analysis: A Strategy for Managing the Water Quality of Pend Oreille Lake (Hoelscher, *et al.* 1993) the physical and biological environment of the lake is as follows:

1. Average water transparency for the southern end of the lake averaged about 29.5 feet (9m) and 18 feet (5.5 m) for the north portion of Pend Oreille Lake. The lower readings for the northern end were attributed to the Clark Fork inflows and wind induced re-suspended sediment from the lake bottom and littoral areas.

2. Water temperature ranged from 66° F to 73°F (2.2°C to 22.5°C). The shallower northern end of the lake was generally two degrees centigrade warmer. Below 164 ft (50 m) water was a uniform 39°F to 41°F (4°to 5°C).

3. Dissolved oxygen concentrations ranged from 7.8 mg/l to 14.0 mg/l.

4. Nutrient concentrations in the euphotic zone [sun lit depths] were, mean total phosphorus 7.6 µg/l with a range from 3 to 16 µg/l; and mean total nitrogen was 137 µg/l. Several studies (Woods 1991b, Greene *et al.* 1984, Gangmark and Cummins 1987) concluded that the limiting nutrient for algae growth was phosphorus, however, one study (Gangmark and Cummins 1987) reported some evidence of phosphorus and nitrogen co-limiting algae growth.

5. Mean chlorophyll *a* concentration was 0.8 µg/l and varied little within the euphotic zone. The range was 0.1 to 1.9 µg/l.

6. Trophic status of the lake was determined to be oligotrophic. The Clark Fork River caused increased turbidity in the northern part of the lake indicative of mesotrophic or eutrophic conditions. However, this lack of transparency was not due to biological production and disregarded in developing the classification.

7. The highest bacteria count found in near shore waters was 50 colonies/100ml.

8. Distribution of nutrient loads into Pend Oreille Lake was also determined by this study. Table 1. lists the source of nutrient and percentage contribution.

Table 1. Distribution of Nutrient Loads Into Pend Oreille Lake and River for water year 1990 (Hoelscher *et al.* 1993).

Source	Nitrogen	Phosphorus
Clark Fork River	81.8%	71.8%
Priest River	6.5%	9.4%
Ungaged runoff	3.5%	5.1%
Atmospheric	3.4%	4.6%
Pack River	2.2%	5.0%
Sand Creek	0.4%	0.5%
Lightning Creek	1.3%	0.9%
Wastewater	0.9%	2.7%

9. A nutrient model developed by Woods (1991a) concluded that small to moderate alterations in the nutrient load would not cause changes in the lake trophic status, however, increases of one-quarter the present nutrient load would move the lake closer to a more productive state (Figure 2).

10. The report also examined the potential for future changes to generate increased nutrients, esp. phosphorus, in the watershed in sufficient quantity to noticeably degrade the lake. Conclusions were that in 20 years the margin of safety between existing conditions (oligotrophic) and impaired (mesotrophic) conditions would be reduced by approximately one half. This assumes a projected County population growth of 8,500 residents for1990-2010 [actual value from 1990 - 1998 was 8,604], and the existing level of County standards for development and stormwater management. The accelerated growth pattern around Pend Oreille Lake is a very real threat to water quality if looked at along a greater than ten year time line. In 1997 Bonner County disbanded their Building Department. As a consequence, building permits were issued and construction was undertaken with little to no regulatory oversight. Therefore both population and county involvement in resource protection were grossly underestimated when the model was developed.

A study attempting to correlate shoreline development with increased near shore eutrophication (Falter et al., 1992) was of particular interest to this investigation to determine if a near shore TMDL for nutrients was warranted. Studies conducted previous to 1989 found little difference in indicators of trophic status over the years, despite intensive development of the area around the lake, however, these studies focused on deep water locations.

Falter's hypothesis was that the near shore areas in the rapidly developing lake area would be the first to show accelerated eutrophication (aging) as a result of increased nutrient inputs (Falter, 1989). Sixteen sites were selected around the lake which represented undeveloped, moderately developed and developed near shore areas. Data collected were bacteria, total phosphorus, chlorophyll a and attached algae, both oven dry weight and ash free oven dry weight.

Conclusions of the two year study were that there was no statistically significant difference between productivity on developed and undeveloped sites of attached algae and filamentous green algae in all cases, even with eight replicates per site. Orthophosphorus levels were similarly not significantly different between sites. Water was more turbid at the north lake sites than at the mid or south lake sites. There was a difference in total phosphorus between

developed and undeveloped sites and a possible shift from diatoms in the 1970's to green and bluegreen algae found in the 1989-90 study. Typical total phosphorus concentrations were 8 to 10 µg/l. These results do not indicate a statistically significant cause and effect relation between developed areas and near-shore cultural eutrophication of Pend Oreille Lake, however, the trend of some of the data did indicate such a relationship. Falter's periphyton sampling was resumed by the Tri-State Water Quality Council in 1998 to establish a statistically valid set of trend data.

Other information in Falter's study closely correlate Lake Tahoe with Pend Oreille Lake as they are morphometrically very similar. It was shown in Lake Tahoe that from the time higher fertility was evident in the nearshore areas, sixteen years later the earliest stages of eutrophication had spread to the pelagic (deep water) zone of the lake. During that same time period urban growth within the watershed has paralleled increases in primary productivity.

During the first comment period for this problem assessment, numerous members of the public responded that nearshore eutrophication was a problem. Attached algae on nearshore rocks and floating algae were cited the most as significantly impairing their use of the lake. The U.S. EPA's "Water Quality Criteria 1972" (blue book) states, "most relatively uncontaminated lake districts are known to have surface waters that contain 10 to 30 µg/l total phosphorus as P; in some waters that are not obviously polluted, higher values may occur."(EPA, 1972). Falter, et al. (1992) reported that the mean total phosphorus level of developed near shore sites in 1989 and 1990 were 10 µg/l and 7 µg/l, respectively.

In a more in-depth investigation, Rothrock studied nearshore periphyton growth in Priest Lake. Rothrock found that Priest had approximately five times the algal biomass of Pend Oreille Lake, even though Priest Lake shows a high quality oligotrophic status (Figures 1 and 2) (Rothrock, 1997). Similar to Falter's findings, Rothrock found that the differences between indicators of pheriphytic algae on developed versus undeveloped shorelines were not statistically significant. In summary, Rothrock pointed out that a number of factors can affect periphytic algal density and productivity within regions of a lake. Some of these factors include ambient nutrient concentrations, tributary enrichment, interstitial phosphorus and nitrogen (seepage of water moving laterally or upward from the lake bottom), abundant fine particulate and colloidal material with attached phosphorus, wave action and grazing by benthic invertebrates. Rothrock recommended further study concerning nearshore algae and its causes, focusing on specific topics of investigation.

Recent studies completed for the hydroelectric dam relicensing effort discovered that dissolved gas, presumably as a result of the spillways at the Cabinet Gorge and Noxon Rapids dam, exceeds Idaho's 110 percent gas saturation standard in the river and lake during periods of high river flow (WWP 1995; Parametrix 1996, 1997). Washington Water Power is studying this phenomenon in more detail.

c. Data Gaps For Determination of Support Status

General

Yearly trend data for nutrient concentrations in the lake is not available. Monitoring stations

should be located in the different limnological zones of the lake and monitored regularly to detect changes in nutrient levels. An active volunteer monitoring program would also be useful for data collection.

Point Sources
The *Rules Governing Point Source Discharges* section (IDAPA 16.01.02.400.) of the Idaho water quality standards does not address the effects of loading to a waterbody, or cumulative effects of multiple point source discharges until a beneficial use is threatened.

Nonpoint Sources
Need to establish what amounts of nutrients and other pollutants are being contributed to the lake by urban stormwater runoff.

Further investigation to determine the degree that periphyton growth is related to human induced nonpoint source nutrients.

4. Problem Assessment Conclusions

Water quality data of the open lake shows little change in trophic conditions from earlier investigations conducted in 1923, 1954, 1975 and 1981 (Falter, 1989). Although threatened over the long term the pelagic zone is slow to change due to the enormous size and depth of the lake. The Tri-State Water Quality Council's "Montana and Idaho Border Nutrient Load Agreement for Pend Oreille Lake Open Water" was created as a cooperative effort between the two states and the Council (Appendix D). If signed, it will provide the best protection possible to maintain the lake's current open water quality. Therefore, at this time a pelagic nutrient TMDL for Pend Oreille Lake is not warranted.

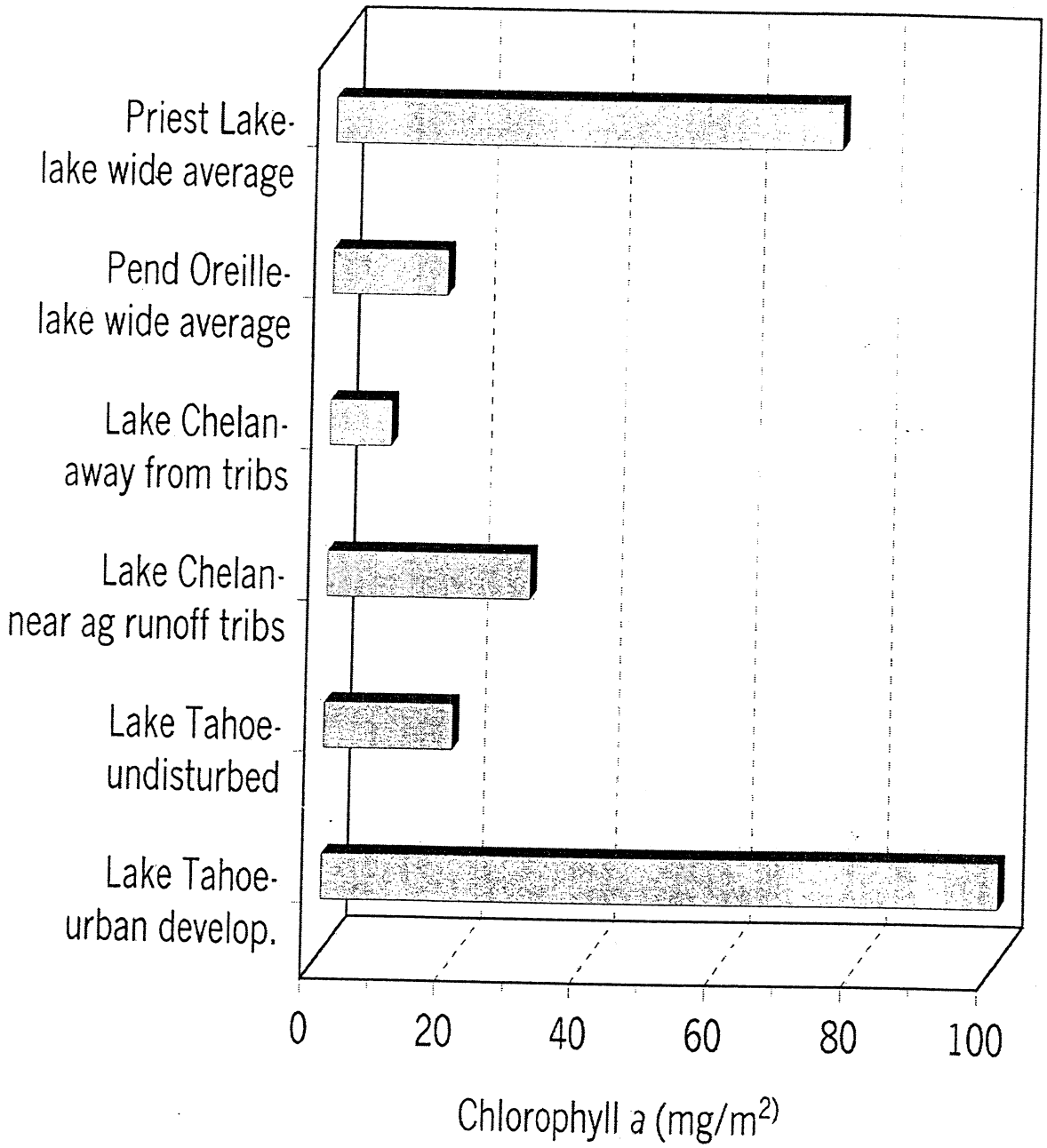
The nearshore areas of Pend Oreille Lake were initially proposed for de-listing. However, due to public input on this issue, comments from EPA and additional information collected in the two years since the de-listing proposal, DEQ now agrees that a nutrient nearshore TMDL should be developed. Factors which were considered in this decision are:

1. Numerous comments from citizens using the near shore areas of the lake indicate that excess nutrients are causing impairment of nearshore uses and that nearshore areas have become increasingly algae rich. These comments were received after it was proposed to de-list the nearshore areas.

2. The 2000 census indicates that the Bonner County has experienced a very high growth rate since 1990. A model developed in 1990 predicted a twenty year window where the margin of safety between an oligotrophic and mesotrophic state would be reduced by one half due to urbanization of the watershed. This prediction was, in theory, met in 1998 based on actual growth rate. If the Lake Tahoe experience is any indication of what could happen in Pend Oreille Lake, it is critical that we control nearshore nutrient enrichment to protect open water quality.

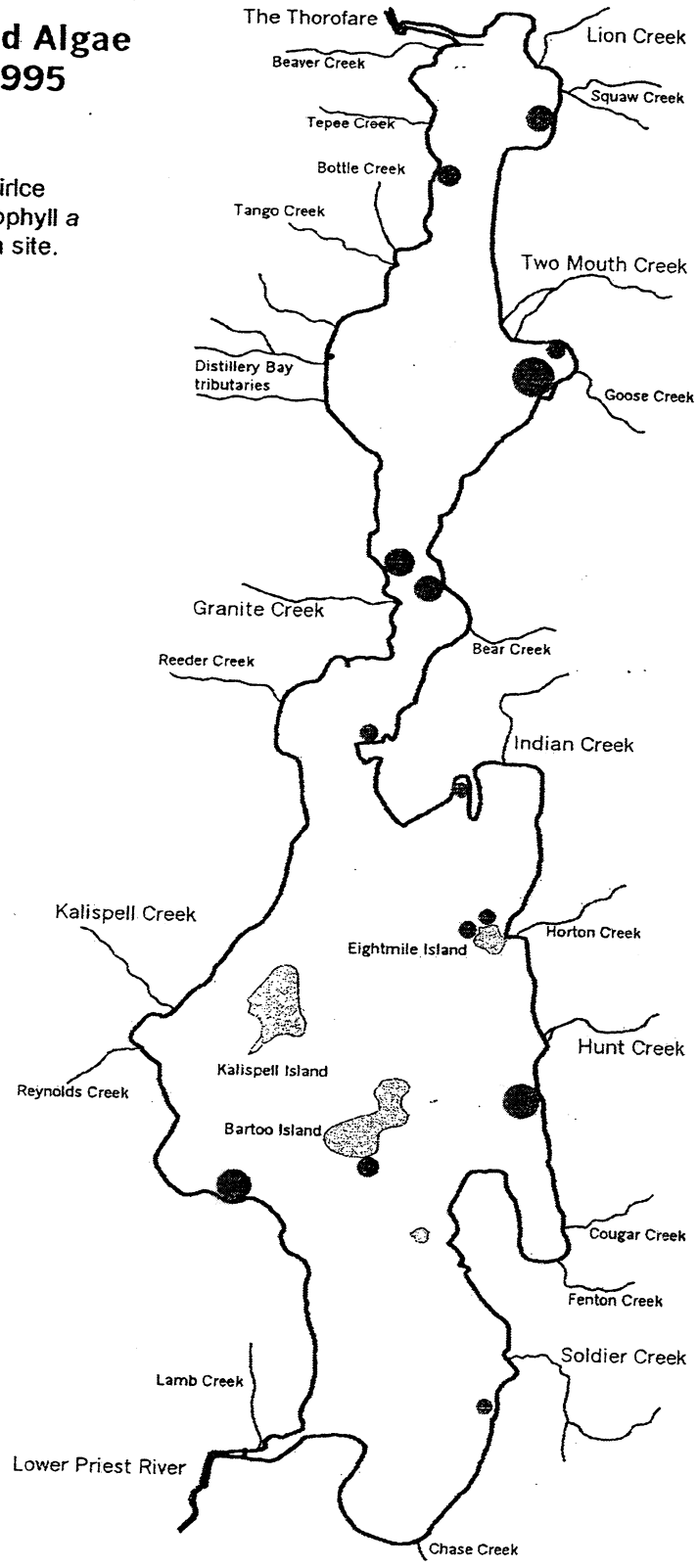
3. Although Bonner County has a good stormwater ordinance, the disbanding of the Building Department from 1997-2001 has greatly reduced enforcement of the ordinance. If stormwater

Algal Biomass Measured on Nearshore Rocks in Various Oligotrophic Lakes



Priest Lake Attached Algae Sampling Sites in 1995

Sampling Sites: size of cirlce represents relative chlorophyll *a* per square meter at each site.



ordinances are not enforced it is likely that in many cases water quality protection measures have not been implemented.

4. The EPA commenting in a December 21, 1999 letter stated that, "...observed changes in phytoplankton community composition from diatoms and chrysophytes to green and bluegreen algae over the past twenty years should be a cause for concern (EPA 1993)." Another comment was, " Particularly given its Special Resource Water status, EPA believes that a natural resource such as Lake Pend Oreille should be managed conservatively to assure protection." EPA also does not believe enough information has been presented to justify de-listing.

The near shore TMDL will be developed and is scheduled to be completed by December 2001. It will have a thirty day comment period for public and agency input prior to its finalization.

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